Planned NASA Research Facilities

**Muscle Atrophy Research Exercise**
- Facilities awaiting launch
  - Microgravity Science Research Rack (MSRR) (2009)
  - Fluids Integrated Rack (FIR) (2009)
  - Window Observation Research Facility (WORF) (2009)
  - Muscle Atrophy Research Exercise System (MARES) (2009)

**Fluids Integrated Rack (FIR)** (2009)
- Facility dedicated to fluid physics research, with Light Microscope Module
- Window to support visual and multispectral remote sensing using Lab Optical Window

**Muscle Atrophy Research Exercise (MSRR)** (2009)
- Facility for musculoskeletal, biomechanical, neuromuscular and neurological physiology measurements

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**Columbus**

**European Space Agency (ESA)**

Research racks launched in Columbus
- European Physiology Module
- Fluid Science Lab
- Biolab
- European Drawer Rack
- European Transport Carrier

External facilities launched with Columbus
- European Technology Exposure Facility (EuTEF)
- SOLAR

**Kibo**

**Japanese Aerospace Exploration Agency (JAXA)**

Research racks launched with pressurized elements or later on HTV
- Ryutai (2008)
  - Fluid physics and thermal control, crystal growth, materials processing unit
- Sutter (2008)
  - Cell biology facility, contains Cell Culture and Cell Biology Experiment Facility, including centrifuge, microscope, incubator
- Kibo (2009)
  - Gradient Heating Furnace for materials processing research

External payloads launched with JEM-EF or later on HTV
- Space Environment Data Acquisition (SEDA) (2009)
- Monitor neutron, plasma, atomic oxygen, and heavy ions
- Monitor All-sky X-ray Image (MAXI) (2009)
  - Obs入市X-ray bursts by Gas Burst Camera and X-ray CCD Camera
  - Superconducting Sub millimeter-wave Limb Emission Sounder (SMILES) (2009)
  - Demonstrate submillimeter sensor technology and conduct submillimeter limb emission sounding of the atmosphere
  - Demonstrate in-situ observation of trace gases in the stratosphere

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**1E flight, December 2007**

**Columbus Module at KSC**

**European Technology Exposure Facility (EuTEF)**

**Flights:** 1J/A Feb 2008, 1J Apr 2008, 2J/A Jan 2009

**Kibo at KSC**

**JEM-EF at KSC**

**Ryutai (Fluids)**

**Sputnik (Cell Biology)**

**Materials (Materials)**

**Monitor All-sky X-ray Image (MAXI)**

**Superconducting Sub millimeter-wave Limb Emission Sounder (SMILES)**

The NASA Authorization act of 2005 designated the U.S. facilities and resources on the ISS as a “national laboratory” (Public Law 109-155, Sec. 507)

- Directed NASA to develop a plan to “increase the utilization of the ISS by other Federal entities and the private sector...”
- As the Nation’s newest national laboratory, the ISS will further strengthen relationships among NASA, other Federal entities, and private sector leaders in the pursuit of national priorities for the advancement of science, technology, engineering, and mathematics.
- The ISS National Laboratory will also open new paths for the exploration and economic development of Space.

- Opportunity to expand the US economy in space-based research, applications and operations.
- Unique and highly visible national asset with surplus capacity available for a wide spectrum of applications.
- NASA will continue to cover cost of operating and maintaining the ISS, and is highly motivated to work with other agencies and organizations to pursue applications.
ISS Event Horizon for National Laboratory Implementation

Calendar Year

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<tbody>
<tr>
<td>National Lab Plan</td>
<td>Assembly Operations</td>
<td>Service Life Extension Decision</td>
<td>Current Service Life End</td>
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“Early utilization” on ISS

- Science completed during assembly
- Early returns during the course of assembly
- Takes advantage of assembly delays, extra crew time
- Means that every crewmember on ISS can be a subject for human research experiments
- More human experiments and target sample sizes over the life of ISS
- Provides information on the potential uses of ISS after assembly is complete

Expedition 14 Research Accomplishments
(September 2006 – April 2007)

- Expedition 14
  - 34 U.S.-integrated investigations
  - 8 completed investigations
  - 136 scientists
- Expeditions 0-14 (May 2000-April 2007)
  - 112 U.S.-integrated investigations
  - 80 completed investigations
  - 373 scientists

Expedition 15 Research Accomplishments
(Oct 2007 – Apr 2008, data as of May 2007)

- Expedition 15
  - 38 U.S.-integrated investigations
  - 11 new investigations
  - 1 reserve investigation
  - 139 scientists

U.S. Investigations on ISS

Outside U.S.: 39
ISS Educational Accomplishments

- K-12 Student participation on ISS 2000-2006
- 66,000 students in inquiry based learning with ISS data
- 800,000 students with classroom versions of ISS experiments
- 31 million had the opportunity to see telecasts from ISS
- 470 undergraduate students
- 251 graduate and postdoctoral students

The Vision for Space Exploration and The ISS National Laboratory

1. Complete assembly of the ISS
2. Develop Orion (Crew Exploration Vehicle)
3. Utilize ISS

On January 14, 2004, the focus of NASA research on ISS was fundamentally changed with President Bush’s Vision for U.S. Space Exploration

- NEW ISS Focus for NASA
  - Astronaut health and countermeasure development to protect crews from the space environment during long duration voyages
  - Testing research and technology developments for future exploration missions
  - Developing and validating operational procedures for long-duration space missions

The Vision for Space Exploration

On January 14, 2004, the focus of NASA research on ISS was fundamentally changed with President Bush’s Vision for U.S. Space Exploration

- ISS Focus for NASA before Exploration Vision: Diverse, multi-discipline research
  - Human Life Sciences
  - Biological Sciences
  - Materials Science
  - Fluids Science
  - Combustion Science
  - And all other sciences!

ISS Medical Project

Experiments on ISS can address:

**SPACE SYSTEM**
- Advanced life support
- Exercise systems
- Clinical capabilities
- Radiation
- Dust

**HUMAN SYSTEM**
- Integrated physiology
- Cardiovascular
- Bone & Muscle
- Neurovestibular
- Food and nutrition
- Immunology & infection
- Human behavior & performance
ISS Medical Project

- ISSMP has been developed to maximize the utilization of ISS to obtain solutions to the human health and performance problems and the associated mission risks of exploration class missions.
- Complete programmatic review with medical operations (space medicine/flight surgeons) to identify:
  - Evidence base on risks
  - Gap analysis
  - Rapid implementation of key studies to optimize human research return

Disciplines Represented in early ISS Research

- Human Research
- Cell Biology and Biotechnology
- Plant Biology
- Physical Sciences
- Technology Development
- Environmental Monitoring
- Earth Observation
- Education

NASA mission-driven Research and the National Laboratory

- ISS for Exploration (NASA mission)
  - Human Research for Exploration
  - Exploration Technology Development
  - Space Operations Improvement
- ISS National Laboratory (Missions of many agencies and organizations)
  - Basic physiology
  - Biology and Biotechnology
  - Physical Sciences
  - Education

Bridging work:
- Microgravity Set-aside
- Education
- Earth Observations